AATCC Review

07 November 2022: Received
23 February 2023: Revised
26 April 2023: Accepted
06 May 2023: Available Online

www.aatcc.peerjournals.net

Research Article Open Access

Integrated nutrient management obsequios for enhancing productivity of mustard- pearl millet cropping system under semi-arid region of Hisar

Shweta[1]*, R. S. Dadarwal[1], Mehak Nagora[3], Kavita Yadav[3], Rajbir Singh Khedwal[2] and Anil Yadav[1]

[1]Department of Agronomy CCS HAU, Hisar, Haryana-India
[2]Oil seed Section, GPB, CCS HAU, Hisar, Haryana-India
[3]Department of Agronomy, CCS HAU, Hisar, Haryana-India

ABSTRACT

Agricultural soil is at serious risk from nutrient mining because there is a large gap between fertilizer input and the extraction of nutrients. A field experiment was conducted during kharif 2020 to Rabi 2020-21, under mustard- pearl millet cropping sequence at Hisar to evaluate the impact of different NPK alone or in combination with FYM on crop productivity. There were fourteen treatments viz., T1- control, T2-100% PK, T3-100% NPK, T4-150% NPK, T5-100% NPK+S @20 kg/ha, T6-100% NPK+Zn @25 kg/ha, T7-100% NPK+B @10 kg/ha , T8-100% NPK+FYM @2.5 kg t/ha, T9-100% NP, T10-100% NK, T11-100% NPK+S @40 kg/ha, T12-100% NPK+S @60 kg/ha, T13-100% NPK+FYM @5.0 kg t/ha, T14-100% NPK+S@20 kg/ha + Zn @25 Kg/ha +FYM @2.5 kg t/ha. Each treatment was replicated thrice in a randomized block design. There was a significant improvement in seed yield over control with an increase in NPK up to 150% RDF (117, 121, 141 and 172% at 100% NK, 100% NP, 100% NPK & 150% NPK, respectively) in the nutrient management practices under long-term mustard based cropping sequence (mustard-pearl millet).It is concluded that over ten years of pearl millet–mustard cropping system, the treatment receiving organic manure along with an optimal dose of chemical fertilizer provided the highest yield of both crops and improved soil fertility. Application of nutrients, both organic and inorganic, maintains the soil fertility status and also maintains crop production in the mustard-pearl millet cropping system.

Keywords: *Mustard-pearl millet cropping system, soil fertility, INM, FYM, Zn, Sulphur*

INTRODUCTION

In India, the area under pearl millet is about 6.93 million hectares with a production of 8.61 million tonnes and national average productivity of 1243 kg/ ha [1]. In Haryana, the area under this crop is 4.2 lakh hectares with production and productivity of 6.9 lakh tonnes and 1609 kg/ha, respectively [2]. Pearl millet is nutritionally better than many cereals and good source of protein having higher digestibility (12.1%), fat (5%), carbohydrate (69.4%) and minerals (2.3%). It is a fast-growing short duration crop that has high biomass production potential and mainly grown in arid and semi-arid regions where moisture is a limiting factor for crop growth [3]. It is an ideal crop with high tillering ability, high dry matter production, high protein content (10-12%) with excellent growth habit, high palatability and better nutritive value.

Oil seed crops, mainly mustard, are an important Rabi season crop in India's agricultural economy. The productivity of mustard can only be raised through balanced fertilization and other management measures, with zinc and sulphur in arid regions of India.

**Corresponding Author: Shweta*
Email Address: Malik.shweta54@gmail.com

DOI: https://doi.org/10.58321/AATCCReview.2023.11.03.19

Pearl millet (Pennisetum glaucum) – mustard (Brassica juncea) cropping system got popularized during last several years under limited and assured irrigated conditions. The biodiversity with intensive cropping is a facetious condition as it causes a serious imbalance in the ecosystem [5]. There is an apprehension that the use of chemical fertilizers over the years might harm the soil fertility. Stagnation or decline in yield has been observed in many cropping systems in many parts of country due to nutrition depletion, imbalances in use of plant nutrients and sub-optimal addition of organic and inorganic fertilizers to soil [9]. There is an apprehension that the use of chemical fertilizers over the years might harm the soil fertility [8]. Integrated plant nutrient supply system has assumed a great importance and is of vital significance for the maintenance of soil productivity and is the need of hour. Organic manures, particularly FYM and vermicompost not only supply macronutrients (in smaller proportion) but also meet the requirements of micronutrients, besides improving soil health and beneficial microbial activities [4],[7]. Long-term fertilizer experiments may provide precise information on the change in soil fertility and productivity and could be of great help in solving the soil fertility problems are of the opinion that use of imbalanced nutrients (N or NP alone) through inorganic fertilizers without organic manure in continuous cropping cannot sustain the desired level of crop production. Integration of organic with organic manures will not only sustain the crop production but will also be effective in improving soil health and enhancing the nutrients use efficiency [10].

MATERIALS AND METHODS

The field experiment was conducted to study Influences of Integrated nutrient management on productivity of pearl millet- mustard cropping system under semi-arid region of Hisar, at Research Farm of CCS, Haryana Agricultural University, Hisar, Haryana, India, situated at 29°10' N latitude and 75° 46' E longitude at an elevation of 215.2 m above mean sea level, during kharif 2020 to Rabi 2020-21. Hisar has a semi-arid climate with severe cold during winter and hot dry and desiccating winds during summer. The maximum temperature is about 45°C during hot summer months of May and June, while during winter months of December and January, the minimum temperature may be subzero annual rainfall of the area is around 450 mm of which, 70-80 per cent is received during the monsoon period i.e., July to September and the rest is received in showers of cyclic rains during the winter and spring seasons. The mean relative humidity remains nearly constant at about 75 to 90 per cent from July to March, steadily decrease in April and remains around 40-50 per cent during hot summer months of May and June. The mean meterological data of crop season 2020-21 given in Fig 1. The soil of the experimental field was sandy loam in texture, with slightly alkaline in reaction with ph 8.0, soil organic carbon (0.34%), available N (162 kg/ha) were low, P2 05 medium (12.3 kg/ha), and high in K20 (330 kg/ha) and S (29 ppm).

The experiment consisted of fourteen treatments laid out in CRBD design with three replications. Crop were sown on October 22, 2020, with hand plough at a row-to-row distance of 30 cm. Thinning was done after about two weeks of sowing to maintain plant to plant spacing of 15 cm. Nitrogen was applied through urea in two splits (half as basal and half at flowering) and phosphorus at seeding through single super phosphate. The crop received only one post sowing irrigation at flowering. All other recommended package of practices was followed for raising the crop. The crop was harvested on March 12, 2021. Yield and yield attributes, oil and content were recorded to draw some valuable conclusions. The recommended dose of N P and K (80kg N 30kg P2 05 /ha and 20 kgK2O)

RESULTS AND DISCUSSION

Mustard yield: Mustard yield significantly affected by all the nutrient treatments. The application of 100 % NPK along with S 20 kg/ha, Zn 25 kg/ha and FYM 2.5 t/ha(T14) produced significantly higher mustard yield (2211 kg/ha) Over control, 100 % PK, 100% NPK + Zn @ 25 kg/ha and 100 % NP.T14 treatment produced 40.81, 24.70,17.01 and 16.64 % higher mustard seed yield over control, 100 % PK, 100% NPK + Zn @ 25 kg/ha and 100 % NK, respectively. There was a significant improvement in seed yield over control with increasing NPK upto 150 % RDF (46,48, 57& 67% at100 NPK, 100% NP, 100%NK & 150% NPK, respectively) in the nutrient management practices in long-term based cropping sequence (mustard-pearl millet). 100% PK (without addition of N) increased the seed yield by 27 % only, which was statistically like the control (1309 kg ha-1) while, the addition of 100% NP (1939 kg ha-1) and 100% NK (2061 kg ha-1) were statistically superior to control (Table1). Application of S, Zn and FYM @2.5t ha-1did not further result in significant increase in seed yield over 100% NPK (1903 kg ha-1). Similar findings reported by workers [6] ,[3]. Improvement in seed yield of mustard was also observed with balanced fertilization, including micronutrient/organics as compared to nutrient in adequacy or imbalance fertilization.

Pearl millet yield: The seed yield of pearl millet was significantly enhanced under nutrient application over control. data revealed that pearl millet yield ranged from 2453 to 3833 kg/ha. T14 treatment have 36.82 % higher grain yield over control. Application of 100 % PK enhances yield 5.98 % while the application of NP has 22.03 % And NK has 13.0 % more yield over control in both seasons (Kharif and Rabi). The increased pearl millet yield is mainly due to the availability of more nutrient and uptake throughout the crop stage, having a beneficial effect on yield contributing factors, also supported by scientists [9].

Oil content and oil yield: Oil content did not differ significantly among all the fertilizer treatments. The highest oil content (39.95%) was found with treatment100%NPK+S@40kgha-1 (Table2).

As oil yield is a product of seed yield and oil content, a similar trend was observed in the case of oil yield as that of seed yield. Maximum seed yield (2181 kg ha-1) and oil yield (858 kg ha-1) were obtained with 150%NPK which was statistically at par with 100% NP, 100% NK, 100 % NPK, the recommended dose of NPK (80+30+20) along with S @40 kg ha-1, Zn @25 ZnSO4 kg ha-1, B @1kg Boron ha-1 and with 2.5 tha-1 FYM.

Mustard-pearl millet system: Mustard-Pearl millet system yield in terms of mustard ranged from 2258 to 3713 kg/ha (Table 3). T14 treatment has maximum system yield because in this treatment mustard and pearl millet have a significantly higher yield, over to control. The system yield might be due to the availability of more nutrient (marco and micro) through both chemical and organic source (FYM) sources. These results are in conformity with the findings of some workers [7],[3].

After 10 years of experiment, it was observed that T14 treatment produced higher mustard seed yield and it was more than double to control (51.31 %), 37.15 % to T2 and 13.72 % to T3 , while 100 % NPK +FYM@5t/ha produced 50.12, 35.52 and 11.50 %more yield over to control, 100 %PK and 100 % NPK, respectively(table 3).

Conclusion: It is concluded that over ten years of pearl millet–mustard cropping system, the treatment receiving organic manure along with optimal dose of chemical fertilizer provided the highest yield of both crops and improved soil fertility.

Future Scope: Responses of INM under different tillage conditions have also not been studied. Thus, in the future, the relationship between tillage and organic and inorganic fertilizer applications should be studied.

Conflict of Interest: The authors declare no conflict of interest.

Acknowledgement: Authors are thankful to, Project Coordinator, AICRP on Rapeseed and Mustard, for providing necessary facilities for conducting research experiments. Authors are also thankful to the Vice Chancellor of CCS HAU, Hisar, for providing me the opportunity to conduct research.

Table 1: Mustard and pearl millet seed yield under different fertility levels.

Treatments		Mustard Seed yield (kg ha^{-1})	% increase over control	Pearl millet yield (kg ha^{-1})	% increase over control
Mustard	Pearl millet				
T_1: CONTROL	CONTROL	1,309		2453	
T_2:100% PK	100% P	1,665	21.41	2600	5.64
T_3:100% NPK	100% NP	1,903	31.23	3233	24.12
T_4:150% NPK	150% NP	2,181	40.00	3447	28.82
T_5:100% NPK + S @ 20 Kg ha^{-1}	100% NP	1,932	32.26	3253	24.59
T_6:100% NPK + Zn @ 5 Kg ha^{-1}	100% NP	1,835	28.69	3267	24.90
T_7:100% NPK + B @ 1 kg ha^{-1}	100% NP	2,007	34.79	3633	32.48
T_8:100% NPK + FYM @ 2.5 t ha^{-1}	100% NP	1,994	34.37	3650	32.79
T_9: 100% NP	100% NP	1,939	32.50	3147	22.03
T_{10}:100% NK	100% N	1,843	28.98	2820	13.00
T_{11}:100% NPK + S @ 40 Kg ha^{-1}	100% NP	2,061	57.53	3680	33.33
T_{12}:100% NPK + S @ 60 Kg ha^{-1}	100% NP	1,918	31.79	3733	34.29
T_{13}:100% NPK + FYM @ 5 t ha^{-1}	100% NP	2,101	37.73	3800	35.44
T_{14}:100% NPK + S @ 20 kg ha^{-1} + Zn @ 5 kg ha^{-1} + FYM @ 2.5 t ha^{-1}	100% NP	2,211	40.81	3833	36.82
C. D. (p=0.05)		346		180	
SEm±		**118**		**520**	
C.V. (%)		**11**		**10**	

Table 2: Ten-year, average mustard yield, oil content and yield under different fertility levels.

Treatments		Average seed yield of mustard (10 years)	Oil content (%)	Oil yield (kg ha^{-1})
Mustard	Pearl millet			

T_1:CONTROL	CONTROL	1063	39.8	521
T_2:100% PK	100% P	1374	39.6	659
T_3:100% NPK	100% NP	1886	39.2	745
T_4:150% NPK	150% NP	2150	39.4	858
T_5:100% NPK + S @ 20 Kg ha^{-1}	100% NP	1909	40.0	772
T_6:100% NPK + Zn @ 5 Kg ha^{-1}	100% NP	1892	39.4	722
T_7:100% NPK + B @ 1 kg ha^{-1}	100% NP	1859	39.9	801
T_8:100% NPK + FYM @ 2.5 t ha^{-1}	100% NP	2011	39.2	782
T_9: 100% NP	100% NP	1839	39.3	762
T_{10}:100% NK	100% N	1718	39.7	732
T_{11}:100% NPK + S @ 40 Kg ha^{-1}	100% NP	1988	39.3	809
T_{12}:100% NPK + S @ 60 Kg ha^{-1}	100% NP	1949	39.3	754
T_{13}:100% NPK + FYM @ 5 t ha^{-1}	100% NP	2131	39.9	839
T_{14}:100% NPK + S @ 20 kg ha^{-1} + Zn @ 5 kg ha^{-1} + FYM @ 2.5 t ha^{-1}	100% NP	2186	39.3	867
C. D. (p=0.05)		-	NS	154
SEm±		-	**0.2**	**51**
C.V. (%)		-	**0.9**	**12**

Table 3: Mustard-pearl millet system yield under different fertility levels.

Treatments		**Mustard equivalent yield**	**System yield (kg ha^{-1})**	**% increase over control**
Mustard	**Pearl millet**			
T_1:CONTROL	CONTROL	949	2258	
T_2:100% PK	100% P	1006	2671	15.47
T_3:100% NPK	100% NP	1251	3154	28.41
T_4:150% NPK	150% NP	1334	3515	35.76
T_5:100% NPK + S @ 20 Kg ha^{-1}	100% NP	1259	3191	29.23
T_6:100% NPK + Zn @ 5 Kg ha^{-1}	100% NP	1264	3099	27.14
T_7:100% NPK + B @ 1 kg ha^{-1}	100% NP	1406	3413	33.84
T_8:100% NPK + FYM @ 2.5 t ha^{-1}	100% NP	1413	3406	33.71
T_9: 100% NP	100% NP	1218	3156	28.46
T_{10}:100% NK	100% N	1091	2934	23.04
T_{11}:100% NPK + S @ 40 Kg ha^{-1}	100% NP	1424	3485	35.22
T_{12}:100% NPK + S @ 60 Kg ha^{-1}	100% NP	1445	3363	32.86
T_{13}:100% NPK + FYM @ 5 t ha^{-1}	100% NP	1471	3572	36.78
T_{14}:100% NPK + S @ 20 kg ha^{-1} + Zn @ 5 kg ha^{-1} + FYM @ 2.5 t ha^{-1}	100% NP	1503	3713	39.19
C. D. (p=0.05)				
SEm±				
C.V. (%)				

REFERENCES

1. Anonymous 2021a : Agricultural statistics at a glance. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmer Welfare. Ministry of Agriculture and Farmer Welfare. Government of India, New Delhi.

2. Anonymous 2021b : Accessed from agriharyana.gov.in. Department of Agriculture and Farmer Welfare

3. Kalaliya, Amit; Sharma, S. K. and Kamboj, B. R. (2022). Nutrient management impacts on grain and stover quality and nutrient uptake of pearl millet *[Pennisetum glaucum* (l) r.br.] Under rainfed conditions. Forage res., 48(3) : pp. 367-371 (2022).

4. Kumar P, Singh R, Singh A, Paliwal D and Kumar S. 2014. Integrated nutrient management in pearl millet-wheat cropping sequence in semi-arid condition of India. *International Journal of Agricultural Sciences*)(1): 96–101

5. Shweta, Kavita, Neelam, Meena Shwag, Satpal, Kamla Malik and Bishan Singh (2022). Evaluation of various maize-based intercropping system. *Forage Research*., 48(2): pp 205-208.

6. Shweta, R. S. Dadarwal, Rajbir Singh Khedwal and Anil Yadav (2023). Influences of Integrated nutrient management on productivity of pearl millet- mustard cropping system under semi arid region of Hisar. *International Conference on Climate Resilient Agriculture for food security and sustainability* (INTCLMATE 2023) at CCSHAU, Hisar from 17-19 February,2023.

7. Singh B; Kumar A; Gupta, V; Abrol V; Singh A P.; Kumar J.; Singh, M.; Dadhich, H And Singh P. (2020). Effect of organic and inorganic nutrients on pearl millet *(Pennisetum glaucum)- Gobi sarson (Brassica napus var. napus) cropping sequence. Indian Journal of Agricultural Sciences* 90 (2): 302–6, February

8. Thakur,R. Sawarkar, S. D.; Vaishya, U.K. and Singh, M.(2011). Impact of continuous use of inorganic and organic manure on soil properties and productivity under soybean- wheat intensive cropping of vertisol. *JISSS*, 59: 74-81.

9. Tomar., P.S. ; Verma, S.K.; Gupta, N and Bansal, K.N(2018). Effect of long term Integrated Nutrient management on productivity of pearl millet *(Pennisetum glaucum)*-mustard *(Brassica juncea)* cropping system and soil fertility in an inceptisol. *JISSS,* 66(3): 295-299

10. Verma, A;Nepalia, V. and Kanthaliya, P.C. (2005).Effect of continuous cropping and fertilization on crop yields and nutrient status of a Typic Haplustept. *JISSS,* 53: 365-368